

PRESS RELEASE



ALMA Project's novel lightweight, efficient and sustainable Battery Electric Vehicle (BEV) structure for passenger cars promises major strides in the EU's green road transport transition away from fossil fuels. The ALMA BEV body-in-white (BiW) is 22% lighter than the baseline design, resulting in a 24% reduction in carbon emissions for the BiW and a corresponding 9% reduction for the entire car over the vehicle's entire service life.

Rotterdam, February 5th, 2024

In a decisive step towards advancing the European Union's Green Deal objectives, the *ALMA Project* (Advanced Light Materials and Processes for the Eco-Design of Electric Vehicles) proudly announces a transformative breakthrough in the road transport sector, attained through sustainable lightweighting. Using an Eco-Design approach and advanced materials, supported by TNO's BEVSIM tool for Life Cycle Assessment (LCA) and Life Cycle Costing (LCC), the ALMA Battery Electric Vehicle (BEV) body-in-white (BiW) structure achieved a remarkable 22% weight reduction. Specifically, a noteworthy 160kg lighter car was achieved compared to the baseline BEV BiW design. The integration of advanced materials and weight reduction in the BiW contributed to a total decrease of 1,850 kg in CO₂-eq (Carbon dioxide equivalent), resulting in a significant 24% CO₂-eq reduction throughout the vehicle's service life. For the entire car, the CO₂-eq reduction was 9%.

According to the sustainable and smart mobility strategy¹, the EU aims to have at least 30 million zero-emission vehicles on its roads by 2030 and achieve a 90% reduction in transport-related greenhouse gas emissions by 2050. The ALMA Project's accomplishment is poised to play a pivotal role in the bloc's commitment to decarbonize road transport and promote circular economy approaches in the automotive industry, a sector known for its significant carbon emissions, material intensity, and end-of-life vehicle disposal challenges.

Alma Advanced Light Materials and Processes for the Eco-Design of Electric Vehicles

Consortium partners:

- CTAG
- ArcelorMittal
- ISCELL
- BATZ
- Innerspec
- Ford
- TNO
- Fraunhofer
- ISWA

The ALMA consortium involves a diverse group of 9 partners from 4 different EU countries: France, Germany, the Netherlands and Spain.

ALMA is an EU Commission funded project with a global ambition.

This project has received funding from the EU Horizon 2020 research and innovation programme under Grant Agreement No. 101006675.

Project Details:

- Start date: 1 February 2021
- Duration: 3 years
- EU contribution: EUR 4.3M

Follow us:

Project Coordination:

The project is coordinated by CTAG - Automotive Technology Centre of Galicia. ctag@ctag.com www.ctag.com

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Alma Redesigning the future of e-mobility through new, sustainable & innovative solutions.

Main Results

ECO-DESIGN OF THE VEHICLE STRUCTURE SUPPORTED BY LCA & LCC

ADVANCED STEEL

EFFICIENT SEPARATION

RECYCLING & RECOVERY

CHARACTERIZATION AND VALIDATION AT TRIL

STRUCTURAL SMC

STRUCTURAL HEALTH INSPECTION

The body-in-white (BiW) of ALMA's concept car is **160 kg lighter**, representing a **22% weight reduction** compared to the baseline BEV BiW. Over the car's entire service life, the use of other materials and weight reduction contributes to a total reduction of **1850 kg CO₂-eq**, a **24% decrease** in emissions.

¹ https://transport.ec.europa.eu/transport-themes/mobility-strategy_en



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ALMA Project Results Presented at Global Automotive Components and Suppliers Expo

In December 2023, the ALMA Project proudly presented its outcomes at the Enlight EVs cluster technology transfer event during the Global Automotive Components and Suppliers (GACS) Expo in Stuttgart, Germany. Consortium partner ArcelorMittal showcased tangible successes through two physical demonstrators – the H-Frame and the Door Ring. These demonstrators validated efficient manufacturing processes and the Multi-Part Integration concept, employing Laser Welded Blanks technology with the utilization of advanced high-strength steels (AHSS).

ALMA Project achievements

Eco-Design Approach for Sustainability

ALMA employed an Eco-Design approach, integrating Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) methodologies, to develop a multimaterial BEV structure. The innovative engineering achieved a 22% weight reduction from the baseline BEV BiW, meeting stringent crash requirements verified through Computer-Aided Engineering (CAE) analysis.

Collaborating with Ford and CTAG, ALMA's holistic circular engineering approach was validated in real-world conditions through multiple crash scenarios. TNO's LCA and LCC tool BEVSIM played a crucial role in evaluating the environmental impacts of materials at each stage, guiding informed decisions to minimize the environmental footprint while ensuring cost-effectiveness and manufacturability.

Efficient Manufacturing and Innovative Materials

Efficient manufacturing processes resulted in fewer references, and ArcelorMittal's integration of high-performance steel grades contributed to reductions in material usage and corresponding vehicle weight savings. ArcelorMittal's Multi-Part Integration concept using Laser Welded Blanks technology consolidated around 10 parts into a single, large component through a single stamping operation, achieving thinner profiles.

BATZ, along with Ford and CTAG, prioritized lightweighting using Sheet Molding Compound (SMC) composites. Key achievements include the development of innovative Battery Lid and

Cowl Panel designs, introducing advanced SMC-Tex endless glass fiber material where necessary to ensure crash protection and structural integrity with a similar performance to that obtained with steels or metals. Fraunhofer ITWM's simulation methods, validated in collaboration with Ford, BATZ, and CTAG, demonstrated crash safety of SMC components while reducing vehicle weight.

Circularity

RESCOLL's reversible assembly method using debondable adhesives ensured cost-effective and efficient separation at end-of-life, promoting circular practices in the automotive industry. Innerspec's structural monitoring system, using acoustic signature analysis, showed promise in assessing wear and potential damages in composites and steel parts, enhancing the vehicle's overall health monitoring system.

Recycling and Recovery of Materials

ArcelorMittal successfully demonstrated the recyclability of Fortiform S1270 through recycling trials. The trials also confirmed that the Ultimate (laminated) steel sheet does not release plastic fragments during shredding, reducing the risk of increased waste in shredded vehicle parts reaching landfills. For both products, tests showed no industrial or environmental issues. Therefore, end of life vehicles' actual way of treatment and recycling can be applied to the new steel products and is thus demonstrated at TRL9. On the other hand, TNO demonstrated the recycling and recovery of composite materials through pyrolysis and solvolysis processes. For both, the quality of recovered materials showed good potential for re-use, either in new materials, or, in the case of pyrolysis, also to fuel the process.

About the ALMA Project

The ALMA Project (Advanced Light Materials and Processes for the Eco-Design of Electric Vehicles) is an EU-funded project under Horizon 2020.² The project consortium involves a diverse group of 9 partners from 4 different EU countries: France, Germany, the Netherlands, and Spain.

The group involves five market-orientated companies, three RTOs and one International association; the members of the consortium, led by CTAG – Automotive Technology Centre of Galicia (Spain), include: ArcelorMittal Maizieres Research (France), Ford-Werke (Germany),

² Horizon 2020 program is the EU Research and Innovation program to fund scientific, industrial, and societal developments within the European Union. Funding for these projects are meant to secure European global competitiveness, particularly in novel breakthroughs and discoveries.

Innerspec Technologies Europe (Spain), BATZ S. Coop. (Spain), RESCOLL (France), Fraunhofer Gesellschaft zur Förderung der Angewandten Forschung E.V. (Germany), Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek TNO (Netherlands) and ISWA - International Solid Waste Association (Netherlands).

The project's objective was to improve the efficiency and driving range of electric vehicles (EVs) through sustainable lightweighting of the vehicle structure, saving energy and materials, thereby reducing carbon emissions. Furthermore, increasing environmental awareness and forthcoming stricter regulations demands the adoption of circular economy principles across the entire vehicle life cycle.

This was a three-year project which aimed to achieve innovation and sustainability. To respond to this challenge, ALMA developed a

novel battery electric vehicle (BEV) BiW structure for a passenger car with around 22% weight reduction compared to current baseline at affordable costs. Thus, ALMA developed a multi-material modular platform made of a combination of Advanced High Strength Steels, Advanced-SMC and steel-hybrid materials, characterized with multiscale model-based tools.

The Circular Economy was at its core. ALMA adopted circular economy principles from early stages through the application of Eco-Design strategies to create a novel BEV platform "made to be recycled". For this purpose, it employed a structural reversible bonding technology to enable the separation of components at the end-of-life (EoL) for repair and reuse. An innovative health monitoring system based on acoustic emissions has been integrated in the structure to detect and locate damage while in-service. To complete the circular loop, efficient recycling and material recovery options were analyzed.

About CTAG

CTAG is a Spanish private, independent, and non-profit technology center devoted to support the automotive industry in its research, development, and innovation needs. CTAG is the project coordinator of the ALMA project. www.ctag.com

About Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. The Fraunhofer Institute for Industrial Mathematics (ITWM) has gained a high reputation in mathematical research for industrial and commercial applications, especially mathematical modelling, and computer simulation. www.fraunhofer.de - www.itwm.fraunhofer.de

About ArcelorMittal Maizières Research

ArcelorMittal Maizières Research (AMMR) is an ArcelorMittal research center devoted to the development of advanced steels for automotive applications. AMMR is WP2 coordinator in the ALMA project. www.corporate.arcelormittal.com

About ISWA – International Solid Waste Association

ISWA is the world's leading network promoting professional and sustainable waste and resource management. www.iswa.org

About TNO

TNO is a Dutch independent research organization which connects people and knowledge to create innovations that boost the competitive strength of industry and the well-being of society. TNO is WP-leader of WP1 (Circular Approach: LCA and LCC) and WP7 (Effective solutions for recycling and recovery) and provides the Circular Economy Manager. [Sustainable society | TNO](https://www.tno.nl/en/sustainable-society)

About Ford-Werke GMBH

Automotive End-User, CAE analysis. As part of the Ford-Werke GmbH, the team of Ford Research & Advanced Engineering Europe is developing the next generation, highly electrified powertrain portfolio. Further research projects are focused on new vehicle concepts as well as new materials and production processes such as additive manufacturing. Safety, comfort and wellbeing aspects are being addressed in the areas of new chassis technologies, advanced driver assistance systems, connectivity and smart mobility solutions. www.ford.de

About RESCOLL

RESCOLL is an innovative SME, best defined as a research company for materials, specialized in composites and polymers. RESCOLL's activities are industrial research and development of innovative products and processes. www.rescoll.fr

About Innerspec Technologies Europe

Innerspec Technologies is the world leader in the development of High-Power Ultrasonic instrumentation for NDT applications. The mission is to provide non-destructive inspection solutions that provide a superior return on investment. www.innerspec.com

About BATZ

BATZ, a first major automotive supplier (TIER1), is a cooperative which belongs to MONDRAGON, the largest cooperative industrial Group in the world. www.batz.com

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